REMARKS

The current application stands with claims 1-48 where claims 1, 17 and 40 are independent but where claims 10-11, 13-16, 26-27, 29-30 and 33-48 are withdrawn. Applicant herein amends claims 1, 5, 17, 20 and 40 for reasons explained below.

Applicant realizes that claim 40 is a withdrawn claim. Claim 40 has the same features as claim 1 plus other features. Thus, Applicant respectfully requests that the Examiner consider the amendment to claim 40 if and when claim 1 has been allowed.

Specification and Claims Rejected under 35 U.S.C. § 112, First Paragraph.

The specification stands objected to, and claims 1-9, 12, 17-25, 28 and 31-32 stand rejected, as failing to provide an adequate written description of the invention and an enabling disclosure under 35 U.S.C. §112, ¶1. In response, Applicant traverses because each feature asserted as missing from the description of the invention by the Examiner is in fact adequately recited in the specification in a way that one skilled in the art does not need to perform undue experimentation to derive the present invention. Each feature asserted as missing from the disclosure is numbered and then explained in turn as follows.

(1) The system configuration including the exact composition of the transmutation product such as density of exposed material.

In response, in the elected species, the diffusing medium comprises lead only, the moderator is made of carbon, the neutron source is a lead only spallation target, and the exposed

material is ^{98}Mo, to produce ^{99m}Tc. Several possible compositions of the product to be transmuted are disclosed in the specification. For example, metallic molybdenum or the oxide MoO_3 is considered on page 35, line 11 and on page 66, line 13. Another possibility is to use the complex salt $K_3H_4[P(Mo_2O_7)_6]$ (page 37, lines 20-22 or page 65, line 8), which can be directly inserted in the activator (page 65, lines 25-26). Yet another possible compound is the salt Na_2MoO_4 (page 34, line 34). Since the specification gives the exact composition of a number of possible products that are used for the invention, the relevant physical quantities, such as density are known and made available to those skilled in the art.

(2) The system configuration including the exact composition of the transmutation product such as the ratio of exposed material to diffusing medium.

In response, Table 6 of the specification (page 38) provides ample numerical data in the case where the exposed material is Na_2MoO_4. In particular, the mass of each element is given. From Table 6, the ratio of exposed material to diffusing medium is readily obtained by comparing the mass values indicated for oxygen, sodium and molybdenum (exposed material) on the one hand, and for lead (diffusing medium) on the other hand.

(3) The system configuration regarding target consistency and how it is mixed?

In response, in the elected species, the neutron source consists of a lead-only spallation target. In an illustrated embodiment, the lead target is in molten form, and the molten liquid is circulated by natural convection through a pipe provided with a heat exchanger and a heater

(page 52, lines 26-31). In this way, the specification describes how the target consistency is achieved.

Otherwise, the question of "how mixed?" raised by the Examiner and as it relates to chemical content is not understood because the target of the elected species consists of pure lead, not of a mixture.

(4) Focusing of the proton beam on the target, i.e. does the beam strike the target only in one area or is the beam focused to strike the target circumferentially, etc.?

In response, page 52 of the specification, lines 20-29, discloses that the molten lead forming the target is circulated at speeds of the order of 1m/s. Accordingly, the proton beam strikes the target in one area (see figures 7a and 7b). That area typically has a diameter of some 10cm in order to avoid damage to the window separating the accelerator tube from the target (page 50, lines 3-6). The target material does not remain in that area, but moves as the molten lead is circulated. Accordingly, some distribution of the impact energy is achieved in the lead material without requiring any means to provide a circumferential inlet of the beam. One skilled in the art will understand this.

(5) Beam application parameters such as intensity, pulsed, continuous, times applied, etc.

In response, the relevant beam parameters are the particle energy E_p, in MeV, and the beam current i_p in mA, which determine the neutron production rate S0 of the source. Intensity

(beam current) values are provided in Table 5, page 48, in the elected case of a high energy particle beam impinging a spallation target.

For this data, the relevant beam current quantity is the average beam current (see page 22, lines 7-8). The neutronics consideration set out in section 2 (beginning on page 28) of the specification hold for a steady state regime to determine the neutron flux distribution (page 19, line 24), which clearly suggests a continuous mode of operation of the neutron source, and thus of the particle beam. However, it is clear that the invention is also compatible with pulsed modes of operation of the accelerator. Possible fluctuations of the beam power will tend to be smoothened by the multiple scattering events which take place in the diffusing medium, so that the neutron flux is eventually equalized when it reaches the region containing the material to be exposed. This is achieved by the "Buffer layer" 3 (page 51, lines 22-28 and page 52, lines 9-19).

Further on (page 63, lines 27-30), the specification suggests a cyclotron or linear accelerator (linac) with 200 (or 150) MeV protons operated at its nominal current of 2.68 (or 5.35) mA. In connection with Table 5, page 48, this is recognized as a continuous mode of operation of the beam.

(6) Operative system temperature and pressure.

On page 52, lines 27-34, it is indicated that the molten lead is circulated by natural convection at speeds of the order 1m/s at a temperature adequate to prevent the liquid from solidifying also when the accelerator is off. The corresponding operating temperature is of the order of 400° C, as explained in page 49, lines 36, around the melting point of lead (327° C).

Indeed, the feature at issue relates to constructive conditions to be fulfilled by the neutron diffusing medium. Thus, if molten lead is merely circulated in channels provided in a nuclear fuel matrix in order to extract heat from such matrix, then the geometry of the system does not fulfil such conditions because neutron scattering within such a lead diffusing medium would not substantially enhance the neutron flux. Such a fuel enhancement by means of a diffusing medium is explained in detail in the specification (e.g. section 2.2, page 30). For these reasons, Applicant respectfully requests that the 35 U.S.C. §112, ¶2 rejection of claim 1 and 17 be withdrawn.

Second and third, claims 3-5 and 18-20 stand rejected due to the term "portion" or "region" recited in claims 3-5 and 18-20 as having no definition, no standard for ascertaining a requisite degree of the features and no indication of its scope. In response, Applicant respectfully traverses because these terms are clearly explained in the specification as understood by one skilled in the art.

The explanation above regarding claim 5 and FIG. 7a adequately explains these features and is repeated in response here. Specifically, it should now be clear that the claimed "portion" 4 and "region" 5 are two distinct parts of the diffusing medium 3, one in which the exposed material is embedded, and the other which is devoid of exposed material. It is submitted that those terms define unambiguous structural limitations of the claims. Even preferred dimensions are provided on page 56. For these reasons, Applicant respectfully requests that the 35 U.S.C. §112, ¶2 rejection of claims 3-5 and 18-20 be withdrawn.

The Examiner further indicates that "*there would be no indication of how and in what manner the diffusing medium provides for the separation of exposed material from the heavy elements in one portion while in another portion the exposed material and heavy elements are combined*". Applicant respectfully traverses since on page 53 of the specification (lines 1-5) it is disclosed that the samples (e.g. Mo compounds) to be activated are embedded in the activation portion 4 by putting them into thin tubes provided in that portion 4. Therefore, some cladding of the exposed material exists as is usual in neutronics applications. The buffer layer or region 5 is free from the exposed materials because the thin tubes are not placed in the region 5. See FIG. 7a and corresponding description. Thus, for the reasons given here, Applicant respectfully requests that the 35 U.S.C. §112, ¶1 rejection of claim 5 for lack of enablement be withdrawn.

Claim Rejections under 35 U.S.C. § 112, Second Paragraph.

Claims 1-9, 12, 17-25, 28 and 31-32 stand rejected under 35 U.S.C. §112, ¶2 as being indefinite first because the Examiner asserts that the terms "so arranged that" recited in claims 1 and 17 merely suggest or make optional certain features, without limiting the scope of the claim (section 9.a of the Office Action). In response, Applicant respectfully traverses.

No indication exists in the content of claim 5 that this is an optional feature. The words are not "so arranged for example that." The Examiner appears to be inserting words or not giving the words their plain meaning. The words clearly indicate that the structure recited in claims 1 and 5 are arranged to derive a certain result as recited in the claims.

Indeed, the feature at issue relates to constructive conditions to be fulfilled by the neutron diffusing medium. Thus, if molten lead is merely circulated in channels provided in a nuclear fuel matrix in order to extract heat from such matrix, then the geometry of the system does not fulfil such conditions because neutron scattering within such a lead diffusing medium would not substantially enhance the neutron flux. Such a fuel enhancement by means of a diffusing

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by one skilled in the art.

The explanation above regarding claim 5 and FIG. 7a adequately explains these features and is repeated in response here. Specifically, it should now be clear that the claimed "portion" 4 and "region" 5 are two distinct parts of the diffusing medium 3, one in which the exposed material is embedded, and the other which is devoid of exposed material. It is submitted that those terms define unambiguous structural limitations of the claims. Even preferred dimensions are provided on page 56. For these reasons, Applicant respectfully requests that the 35 U.S.C. §112, ¶2 rejection of claims 3-5 and 18-20 be withdrawn.

Claim Rejections over Prior Art under 35 U.S.C. §102.

Claims 1-9, 12, 17-20, 23-25 and 28 stand rejected under 35 U.S.C. 102(b) as being anticipated by Bowman (U.S. .5,160,696). In response, Applicant respectfully traverses because the cited reference does not disclose or suggest a diffusing medium substantially transparent to neutrons as recited in claims 1 and 17.

Bowman discloses an apparatus for nuclear transmutation and power production using an intense accelerator-generated thermal neutron flux in the range of at least 10^{16}n/cm^2/s (column 13, lines 9-10). This is an order of twice the magnitude of what is typically used in the present invention as disclosed (see Table 5, page 48).

Bowman discloses thermal breeding and other prospects for the accelerator-driven lead-bismuth target surrounded by a blanket with molten salt containing fissionable material, fertile material, material to be transmuted, etc. (column 8, lines 12-16). Referring to figure 4 of Bowman, incoming high-energy protons 80 are introduced into an enclosure 84 containing a lead-bismuth mixture circulated along a loop 88. The lead and bismuth elements form a spallation target, i.e. a neutron source which is surrounded by a blanket containing a heavy water moderator 44 and part of a molten salt recirculation loop 94. The blanket medium contains both the molten salt (e.g. ^{7}LiF/BeF$_2$) and the fertile or fissile materials as well as fission products thereof (column 11, lines 22-24). The object of the molten salt recirculation loop is to extract both heat (by means of the heat exchanger 96) and undesirable fission products (by means of a "processor" 48). Waste material to be transmuted can be inserted into containment means 98 located in blanket region, for irradiation and transmutation of the waste.

The Examiner considers the molten salt mixture of Bowman to be a "neutron-diffusing medium" as recited in independent claims 1 and 17 of the present application. On that basis, he notes that the waste material to be exposed to a neutron flux according to Bowman is distributed in such "neutron-diffusion medium" as illustrated by the reference numeral 98 in figure 4.

As pointed out hereabove, the blanket medium, located within the cylindrical enclosure surrounding the inner enclosure 84, is a mixture of molten salts and of a fuel material including both fertile and fissile elements, along with fission products. This liquid medium is circulated along a loop 94 in order to separate the fission products.

The overall design is a target/blanket configuration, i.e. neutron capture and fission reactions take place within the blanket, i.e. within the molten salt medium. The neutron capture reactions by ^{232}Th or ^{238}U as well as by the intermediate species ^{233}Pa or ^{239}Np have a very significant probability at neutron fluxes of the order of $10^{16}n/cm^2/s$. An even more important source of neutron interaction within the blanket medium is the fission reaction of ^{233}U or ^{239}Pu. The fission products also have signification neutron absorption cross-sections (this is why they have to be removed by the processor 48).

Accordingly, Bowman's blanket medium is not substantially transparent to neutrons. On the contrary, inelastic processes are quite dominant over elastic scattering when the neutron balance is considered. In other words, Bowman completely fails to disclose or suggest the important claimed feature of neutron transparency (see page 2, line 29 – page 3, line 7 of the specification). This is a fundamental part of the present invention.

It also results in the fact that neutron scattering within such a diffusion medium does not enhance the neutron flux. Bowman's neutron flux is high because of the huge beam power (column 5, lines 7-10: 400 MW) and of the fission reactions.

Because no evidence exists in Bowman that its diffusion medium is substantially transparent to neutrons, Applicant respectfully requests that the 35 U.S.C. §102(b) rejection based on Bowman of claims 1 and 17, and their dependent claims, be withdrawn.

Claim Rejections under 35 U.S.C. §103.

Claims 21-22 have been rejected as being "unpatentable" over Bowman in view of Borst, and claims 31-32 have been rejected as being "unpatentable" over Bowman and further in view of Ruddock (U.S. 4,123,497). In response, Applicant traverses because claims 21-22 and 31-32 directly or indirectly depend from claim 17, and therefore include all of the features of claim 17 plus other features. Thus, Applicant repeats the same argument mentioned above to overcome the §102(b) rejection of claim 17 and applies it here to overcome the present rejection. Specifically, all of the cited references: Bowman, Borst and Ruddock do not disclose or suggest a diffusing medium substantially transparent to neutrons. Thus, Applicant submits that the §103 rejection of claims 21-22 and 31-32 has also been overcome. For this reason, Applicant respectfully requests that the §103 rejection of claims 21-22 and 31-32 be withdrawn.

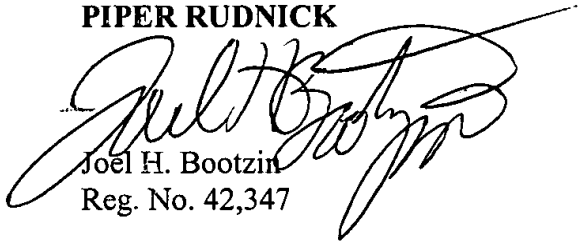
Independent Claim 40 and claims 41-48 which depend thereon have been withdrawn from consideration due to the election of species. Since claim 40 contains all the features of Claim 1 plus additional features, which is believed to be allowable, the allowance of claim 1

should result in the allowance of claims 40-48 as well. Consideration of claims 40-48 upon the allowance of claim 1 is respectfully requested.

For all of the reasons mentioned above, Applicant respectfully requests consideration and allowance of all pending claims. The Examiner should contact the undersigned attorney if an interview will expedite prosecution.

Respectfully submitted,

PIPER RUDNICK



Joel H. Bootzin
Reg. No. 42,347

P.O. Box 64807
Chicago, IL 60664-0807
(312) 368-7072
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